



Astronomers rely on scientific notation in order to work with 'big' things in the universe. The rules for using this notation are pretty straightforward, and are commonly taught in most 7th-grade math classes as part of the National Education Standards for Mathematics.

The following problems involve the multiplication and division of numbers expressed in Scientific Notation. For example:

$$1.34 \times 10^8 \times 4.5 \times 10^6 = (1.34 \times 4.5) \times 10^{(8+6)} \\ = 6.03 \times 10^{14}$$

$$3.45 \times 10^{-5} / 2.3 \times 10^6 = (3.45/2.3) \times 10^{(-5 - (6))} \\ = 1.5 \times 10^{-11}$$

- 1) Number of nuclear particles in the sun:  $2.0 \times 10^{33}$  grams /  $1.7 \times 10^{-24}$  grams/particle
- 2) Number of stars in the visible universe:  $2.0 \times 10^{11}$  stars/galaxy x  $8.0 \times 10^{10}$  galaxies
- 3) Age of universe in seconds:  $1.4 \times 10^{10}$  years x  $3.1 \times 10^7$  seconds/year
- 4) Number of electron orbits in one year:  $(3.1 \times 10^7$  seconds/year) /  $(2.4 \times 10^{-24}$  seconds/orbit)
- 5) Energy carried by visible light:  $(6.6 \times 10^{-27}$  ergs/cycle) x  $5 \times 10^{14}$  cycles
- 6) Lengthening of Earth day in 1 billion years:  $(1.0 \times 10^9$  years) x  $1.5 \times 10^{-5}$  sec/year
- 7) Tons of TNT needed to make crater 100 km across:  $4.0 \times 10^{13}$  x  $(1.0 \times 10^{15}) / (4.2 \times 10^{16})$
- 8) Average density of the Sun:  $1.9 \times 10^{33}$  grams /  $1.4 \times 10^{33}$  cm<sup>3</sup>
- 9) Number of sun-like stars within 300 light years:  $(2.0 \times 10^{-3}$  stars ) x  $4.0 \times 10^6$  cubic light-lys
- 10) Density of the Orion Nebula:  $(3.0 \times 10^2$  x  $2.0 \times 10^{33}$  grams) /  $(5.4 \times 10^{56}$  cm<sup>3</sup>)

## Answer Key:

1) Number of nuclear particles in the sun:  $2.0 \times 10^{33}$  grams /  $1.7 \times 10^{-24}$  grams/particle  
 **$1.2 \times 10^{57}$  particles (protons and neutrons)**

2) Number of stars in the visible universe:  $2.0 \times 10^{11}$  stars/galaxy x  $8.0 \times 10^{10}$  galaxies  
 **$1.6 \times 10^{22}$  stars**

3) Age of universe in seconds:  $1.4 \times 10^{10}$  years x  $3.1 \times 10^7$  seconds/year  
 **$4.3 \times 10^{17}$  seconds**

4) Number of electron orbits in one year:  $(3.1 \times 10^7 \text{ seconds/year}) / (2.4 \times 10^{-24} \text{ seconds/orbit})$   
 **$1.3 \times 10^{31}$  orbits of the electron around the nucleus**

5) Energy carried by visible light:  $(6.6 \times 10^{-27} \text{ ergs/cycle}) \times 5 \times 10^{14} \text{ cycles}$   
 **$3.3 \times 10^{-12}$  ergs**

6) Lengthening of Earth day in 1 billion years:  $(1.0 \times 10^9 \text{ years}) \times 1.5 \times 10^{-5} \text{ sec/year}$   
 **$1.5 \times 10^4$  seconds or 4.2 hours longer**

7) Tons of TNT needed to make crater 100 km across:  $4.0 \times 10^{13} \times (1.0 \times 10^{15}) / (4.2 \times 10^{16})$   
 **$9.5 \times 10^{11}$  tons of TNT (equals 950,000 hydrogen bombs!)**

8) Average density of the Sun:  $1.9 \times 10^{33} \text{ grams} / 1.4 \times 10^{33} \text{ cm}^3$   
**1.36 grams/cm<sup>3</sup>**

9) Number of sun-like stars within 300 light years:  $(2.0 \times 10^{-3} \text{ stars}) \times 4.0 \times 10^6 \text{ cubic light-lys}$   
 **$8.0 \times 10^3$  stars like the sun.**

10) Density of the Orion Nebula:  $(3.0 \times 10^2 \times 2.0 \times 10^{33} \text{ grams}) / (5.4 \times 10^{56} \text{ cm}^3)$   
 **$1.1 \times 10^{-21}$  grams/cm<sup>3</sup>**